Argentine stem weevil: farmer awareness and the effectiveness of different ryegrass/endophyte associations

A.J. POPAY1, K. RIJSWINKEL2 and S.L. GOLDSON3

1AgResearch Ruakura, Private Bag 3123, Hamilton 3240, New Zealand
2 Wageningen University and Research, Knowledge, Technology and Innovation Group, The Netherlands
3 AgResearch, Lincoln Science Centre, Private Bag 4749, Christchurch 7674, New Zealand

alison.popay@agrresearch.co.nz

Abstract

Argentine stem weevil (ASW) is a highly destructive pest of ryegrass that has recently been associated with increased incidences of field damage. A survey of farmer awareness and management practices in relation to this pest was carried out. Many (47%) farmers sowed favoured plant hosts such as short-term and tetraploid ryegrasses. A field trial, undertaken near Hamilton, compared the effects on ASW larval damage of 10 different ryegrass/endophyte associations in comparison with an endophyte-free control with and without seed treatment. U2 endophyte in a diploid perennial festulolium and AR37 endophyte in a hybrid tetraploid, an Italian diploid and a tetraploid perennial ryegrass had significantly less damage (<26%) than all other treatments (>42%). NEA2 endophyte in a diploid perennial ryegrass and AR1 endophyte in short-term ryegrasses failed to protect plants from severe damage by this pest. Farmers need to be aware of the risks of ASW damage to short-term and tetraploid ryegrasses.

Keywords: ploidy, short-term ryegrasses, larval damage, endophyte strains, pasture management

Introduction

Argentine stem weevil (ASW) (Listronotus bonariensis) is one of New Zealand’s most destructive grass and cereal pest. First reported in the country in 1927, this small cryptic insect occurs throughout New Zealand. Adult weevils feed on the emergent cotyledons of newly sown grasses and cereals, killing young seedlings (Goldson et al. 1998). The larval stages mine inside tillers, often killing the meristem and causing widespread tiller death in susceptible hosts. Between September and March ASW undergoes at least two generations in most areas except where cool temperatures (e.g. southern South Island) may slow its development allowing only one generation per year (Barker et al. 1989; Goldson et al. 1998). Damage is particularly apparent in the summer/autumn, but is often wrongly attributed to drought (Whatman 1959).

An important discovery in the early 1980s showed that a seed-transmitted fungal endophyte (Epichloë festucae var. lolii; formerly Neotyphodium lolii) infecting perennial ryegrass (Lolium perenne), which had become naturalised in New Zealand, provided its host with resistance to ASW. The host endophyte strains that minimised or eliminated the mammalian toxicity caused by the naturalised common toxic strains. New strains were introduced that did not produce the two toxins ergovaline and lolitrem B or produced them at low concentrations. In 2001, AR1, an endophyte producing the ASW deterrent, peramine, but not the toxic alkaloids was commercialised (Thom et al. 2012). This was followed in 2007 by the release of AR37 which produces epoxy-janithrems but not peramine, ergovaline or lolitrem B. Since then seed companies have commercialised their own E. festucae var. lolii endophyte strains such as NEA2, that rely on low production of peramine and the toxic alkaloids and an E. uncincta endophyte, U2, isolated from meadow fescue, which produces loline alkaloids. U2 is now available in a Festulolium cv. “Barrier” which has many of the characteristics of its meadow fescue parent.

A parasitoid (Microctonus hyperodae), that sterilises adult ASW, was imported and released in the early 1990s to provide additional control of this pest, particularly in susceptible plants not protected by endophyte. Popay et al. (2011) reported on incidences of ASW damage in the field, concluding that parasitism may no longer be suppressing populations. Recently, a decline in parasitism levels has been confirmed (Goldson et al. 2014; Tomasetto et al. 2017). Although the reasons for this decline have yet to be identified, the situation has led to concerns about farmers’ current awareness of ASW and their decision-making with regard to managing it. Seedling ryegrass and cereals that are susceptible to adult and larval damage at establishment need to be protected by seed treatment. In addition, susceptibility to ASW is higher in Italian and annual species (Lolium multiflorum) and tetraploid perennial ryegrasses compared with diploid perennials (Goldson 1982; Barker 1989; Prestidge 1991; Popay et al. 1995) that may not always be overcome by endophyte-infection (Popay et al. 2003). This paper reports on a survey seeking to gauge farmers’ level of knowledge...
of ASW, as well as to understand what governs their decision making process of farmers and growers in relation to insect pest management in general and ASW in particular. The survey had a sample size of 500 different farmers and growers from dairy, sheep and beef, and arable sectors with an equal distribution of 50 different farmers and growers from dairy, sheep and beef, and arable sectors with an equal distribution of 500 different farmers and growers from dairy, sheep and beef, and arable sectors with an equal distribution among the main regions of New Zealand, resulting in a stratified random sample of the total population. The contact details were obtained from a database owned by AssureQuality. Unfortunately, technical difficulties impacted on already tight timeframes and a digital survey was no longer deemed feasible. Instead, a telephone survey was undertaken, using the same questions as would have been used in the digital survey. A sample of 2000 telephone numbers was created using AssureQuality’s database, with the same requirements for ASW damage. Data from live tillers with the expected endophyte status (positive for endophyte-infected, or endophyte-free in ‘Nil’ treatments) were analysed. Analyses were performed for the oviposition and larval damage variables. The analyses were carried out using Minitab version 16. The host/ endophyte combinations used in the trial did not allow analyses for effects of ploidy and ryegrass species to be undertaken.

### Results

#### Farm survey

There was an over representation of sheep and beef farmers in the sample of 100 farmers that were surveyed, with 77% in this category although 22 of these farmers also had involvement in other sectors, for example, dairy farmers and/or cropping. A total of 13 respondents were dairy farmers. The majority of the respondents were over 55 and male. They predominantly had co- ownership of the farm, with more than 15 years farming experience, and the majority came from Canterbury (n=18), Manawatu-Wanganui (n=16), Otago (n=14) or the Waikato (n=13) regions. The results hence show the major factor. Of the 20 respondents who had sown cereals, 80% used insecticide-treated seed, whereas only 61% of farmers who had sown ryegrass used treated seed and 19% reported not using any seed treatment. The majority of farmers who had sown either cereals or grasses were either very satisfied (50%) or satisfied (40%) with establishment. Insect pests were regarded by most respondents as a large proportion of the farmer population in New Zealand. Insect pests were regarded by most respondents as a large proportion of the farmer population in New Zealand. Insect pests were regarded by most respondents as a large proportion of the farmer population in New Zealand. Insect pests were regarded by most respondents as a large proportion of the farmer population in New Zealand.
as for productivity (75%) and persistence (73%). Hence the majority also regarded the use of seed treatment (84%) and selection of endophyte (68%) to be important or very important. Despite this, 50 of the 65 respondents who had sown grasses or cereals reported that they were unaware of any insect pest damage during the establishment phase. The remaining 15 thought more than one insect pest was a problem, with only two reporting ASW and/or clover root weevil as a cause of damage during establishment. Those who had sown grasses or cereals the previous year tended to be more confident in recognising insect damage.

When specifically asked about ASW, 92% of respondents had heard of this insect, but only 25% considered it to be important. This lack of concern was not necessarily based on a well-informed decision. Four respondents were not concerned about ASW because they were well informed about insect pests on their farm, for example, through a farm consultant. On the other hand, three respondents gave lack of information as a reason for not being concerned, saying “I don’t really know what I’m looking for. I rely on the fact that others say, that by far the most important in this area is grass grub and black beetle.” or “I haven’t been educated in recognising it.” Moreover, most of those who did not consider ASW to be important on their farm attributed this to their location (e.g. southern parts of New Zealand or steep hill country). Of those 23 respondents that were concerned about ASW, at least one respondent had mistaken it for clover root weevil saying “It just devastates all the clover.” Figure 2 shows that the confidence levels in recognising ASW damage varied widely; 30% said that they were somewhat confident, 27% were confident, and 24% were not confident. These results in combination with the likelihood of others confusing ASW and clover root weevil indicate that the respondents overall were not particularly aware of ASW and its damage.

**Discussion**

Several interesting points emerged from the farmer survey. Given a national average annual rate of renewal of pastures in New Zealand of 3-4% (Pasture Renewal Charitable Trust: http://www.pasturerenewal.org.nz/), the proportion of respondents in the survey who had sown new pastures in the previous year (62%) was high. Many of these were using the short-term grasses (Beeley) which were considered of low concern to ASW. Use of seed treatment to protect young grass and cereal seedlings at establishment was common, although some chose not to, thereby running the risk of insect damage. The vast majority of farmers used endophyte, with endophyte choice based on experience, although many did not know which endophyte they had used. Most reported a high level of satisfaction with establishment of their new sowings.

Although 92 farmers had heard of ASW before, many farmers thought this insect was not posing a risk to them due mainly to their farm location. The main reasons given by respondents were located in (Waikato, Manawatu-Wanganui, Canterbury, Otago), however, are all likely to be vulnerable to ASW, with the possible exception of Otago. Cool temperatures in this and the Southland region were thought to restrict the potential for ASW to northern regions of New Zealand. We are grateful to AssureQuality for the use of their database, Heather Rhodes for assistance with analysis of the farmer survey, and Hamish Johnstone and Derrick Wilson for assistance with sowing. David Anderson assisted with sampling plots and Chikako van Koken conducted the statistical analysis.

**REFERENCES**


Lime application can help protect pastures against black beetle

P.J. GERARD and D.J. WILSON

AgResearch Ruakura, Private Bag 5123, Hamilton 3240, New Zealand

pip.gerard@agresearch.co.nz

Abstract

Black beetle attacks pasture grasses in the northern and coastal North Island and with a warming climate, the beetle has extended its range and damage has become more prevalent. On-farm investigations into prevention of damaging populations suggested that black beetle density was inversely related to soil pH. Two replicated block experiments, the first in 2013-2015 on two farms, and the second on four farms in 2015-2017 investigated the effects of late spring agricultural lime applications at the rate of 5 tonne/ha on summer black beetle populations. The results showed that lime can help suppress black beetle populations. Importantly, the effect of lime persisted into the second year in Trial 2, preventing larval populations reaching damaging levels of over 40/m². This adds to the already well-known benefits of lime in improving soil health and pasture quality, vigour and persistence.

Keywords: agricultural lime, soil pH

Introduction

Black beetle (*Heteronchus arator* (Fabricius)) is a subtropical pest of pastures in New Zealand. Damage to perennial ryegrass in farm systems to improve farmer outcomes - a review. *Crop and Pasture Science* 63: 927-943.


Important factors contributing to damaging black beetle populations are above average temperatures, free-draining soils and availability of favourable food resources. Widespread black beetle outbreaks are associated with strong La Niña weather patterns which, on average, bring warmer than normal temperatures over the North Island in spring and autumn (*Gerard et al.* 2013). High spring temperatures (growing degree days above 15°C, *King et al.* 1981b) encourage population increase while wet conditions are unfavourable for early instar larval survival (*King et al.* 1981c). C₄ grasses, as well as ryegrasses (*Lolium* spp.) without a deterrent endophyte, are favourable hosts (*King et al.* 1981a; Blanc & Olson 1988; Bell & Prestidge 1992). In contrast, adult feeding, and in turn survival and oviposition are reduced by ryegrasses containing standard, AR37, NEA2 or Endo 5 endophytes (*Ball et al.* 1997; Popay & Balsam 2001; Bell et al. 2011).

A major outbreak of black beetle occurred in Waikato and Bay of Plenty from 2007 to 2010, and many farmers experienced widespread failure of perennial pastures (*Bell et al.* 2011). While climate and black beetle were not the only factors, losses were reported of about $1300/ha/year during this period (*Reynolds 2013*). Since then, the widespread use of black beetle-active ryegrass endophytes, in particular AR37, has enabled pastures to persist even under drought conditions (*Thom et al.* 2014). However, with ongoing higher annual temperatures, pastures on peat or light soils still experience damage. Consequently there remains a high demand for additional practical tools to help combat this pest in established pastures.

In the course of analysing data gathered from 12 paddocks across five Waikato farms during a black beetle/pasture persistence study, it was found that black beetle density was inversely related to soil pH (*Gerard et al.* 2013). This paper reports on field studies undertaken to investigate if the application of agricultural lime can help reduce black beetle populations.

Methods

Trial 1: 2013-2015

The trial was a randomised block design consisting of four paddocks on Waikato dairy farms, two on a farm with peat soils (Taupiri 1 and 2, 37°37'03.8"S 175°38'50.0"E) and two on a farm with ash soils (Waihou 1 and 2, 37°32'01.5"S 175°38'50.0"E). Each paddock (block) was divided into eight plots and Ag.lime supplied by McDonalds Lime (now Graymont) was applied at the rate of 5 tonne/ha to four randomly selected plots in each paddock on 4 November 2013, by the commercial operator, Wealleans, using a purpose built 4x4 ground-spreading vehicle. The timing of the lime application was during the black beetle oviposition period.

Black beetle populations were sampled by taking five 20 x 20 cm square samples of turf to a depth of 15 cm and hand sorting in the field. This was done in December (a month after lime application) when the black beetle